# PATENT ABSTRACTS OF JAPAN

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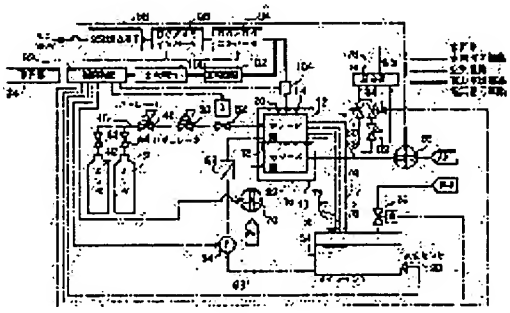
## (54)SOLID POLYMER FUEL CELL SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To exhaust an adequate amount of fuel gas from an anode side gas chamber of a solid polymer fuel cell main body, even in either the case of a low load and a high load.



SOLUTION: When the supply of hydrogen gas from a gas cylinder 42 to a fuel cell main body 10 starts, when a current generated in the fuel cell main body 10 is less than a threshold, a control device 92 opens an electromagnetic switch valve 84, closes a path to a high load needle valve 82 in a gas exhaust pipe 76, exhausts the non-reaction gas of an anode side gas chamber 14 only through a low load needle valve 80, and when a current generated in the fuel cell main body 10 is 20 A or higher, the control device 92 opens the electromagnetic switch valve 84, opens the high load needle valve 82 in the gas exhaust pipe 76, and exhausts the non-reaction gas in the anode side gas chamber 14 through both the low load needle valve 80 and the high load needle valve 82.

NOTICES *



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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the polymer electrolyte fuel cell device which the fuel gas which uses hydrogen gas as the main ingredients is supplied, and generates electric power.
[0002]
[Description of the Prior Art]Since it becomes possible to generate electric power by supply of the fuel gas which uses hydrogen gas as the main ingredients, a polymer electrolyte fuel cell device does not need the charge before the beginning of using as compared with a storage battery. The increase in demand will be predicted by such advantage from now on as a power supply of the for the outdoor type and for emergencies in a polymer electrolyte fuel cell device.
[0003]The composition of the main part of a polymer electrolyte fuel cell used for the above polymer electrolyte fuel cell devices is shown in drawing 3. The anode pole side air space 14 which uses the electrode conjugate 12 as a septum, and the cathode pole side air space 16 are formed in the inside of the main part 10 of a polymer electrolyte fuel cell (henceforth a fuel cell body). As shown in drawing 3, the anode pole 20 is arranged on one field of the electrolyte 18, the cathode pole 22 is arranged on the field of another side, respectively, and the electrode conjugate 12 is formed filmy as a whole. The anode pole 20 and the cathode pole 22 are constituted by the catalyzer electrode 24 which consists of platinum etc., respectively, and the charge collector 26 laminated on this catalyzer electrode 24, and these anode poles 20 and the cathode pole 22 are connected to the external circuit 28. Here, as the electrolyte 18, a polymers ion-exchange membrane (for example, fluoro-resin system ion-exchange membrane which has a sulfonic group) is used.
[0004]Hydrogen gas of a high grade is supplied to the anode pole side air space 14 of the fuel cell body 10 constituted as mentioned above as fuel gas from a cylinder, a reformer (graphic

display abbreviation), etc., and water is supplied with a pump etc. and air is supplied to the cathode pole side air space 16 by a fan etc. The hydrogen supplied to the anode pole side air space 14 is ionized on the anode pole 20, and this hydrogen ion sets the inside of the electrolyte 18 to $H^+$ and $xH_2O$ with a water molecule, and moves to the cathode pole 22 side. The hydrogen ion which moved to this cathode pole 22 side reacts to the electron which has flowed through oxygen and the external circuit 24 in the air on the cathode pole 22, and generates water. Since an electron flows through the external circuit 28 with the generation reaction of this water, it becomes possible to use this electron flow as electrical energy of a direct current.

[0005]According to the power consumption of the external circuit 28, the hydrogen gas supplied to the anode pole side air space 14 of the fuel cell body 10 as described above serves as a hydrogen ion, and is consumed. However, impurity gas, such as nitrogen and carbon dioxide, is mixed in hydrogen gas of industrial use, or the hydrogen gas generated from propane etc. by the reformer. Within the anode pole side air space 14, since only hydrogen gas is consumed, consumption of hydrogen gas increases and impurity gas condenses. If the concentration of the impurity gas which remains in the anode pole side air space 14 becomes high, ionization of hydrogen gas in the anode pole 20 will be controlled, and the maximum output of the fuel cell body 10 will decline.

[0006]In order to prevent the concentration of the impurity gas in the anode pole side air space 14 from becoming high, there is a thing of the structure which discharges a small amount of hydrogen gas which always contained impurity gas from the anode pole side air space 14 at the time of a device operation to the exterior of the fuel cell body 10 in the conventional polymer electrolyte fuel cell device. In such a polymer electrolyte fuel cell device, flow control valves, such as a needle valve, are connected to the anode pole side air space 14, and a small amount of hydrogen gas is discharged from the anode pole side air space 14 to the exterior of the fuel cell body 10 via this flow control valve.

[0007]

[Problem(s) to be Solved by the Invention]However, in the above polymer electrolyte fuel cell devices, the power consumption of an external circuit increases and consumption of hydrogen gas by a fuel cell body increases. For this reason, since the load to a fuel cell body increases and concentration of impurity gas is promoted, if a lot of hydrogen gas is not discharged from the anode pole side air space as compared with the time of low loading at the time of a heavy load, the performance of a fuel cell body is unmaintainable. So, in the conventional polymer electrolyte fuel cell device, the valve opening of a flow control valve is set up so that hydrogen gas of a discharge which is needed at the time of a heavy load may be discharged. As a result, in the conventional polymer electrolyte fuel cell device, hydrogen gas whose concentration of impurity gas is lower than the time of a heavy load will be discharged from the anode pole side

air space outside at the time of low loading, and the ratio (power conversion efficiency) from which the hydrogen gas supplied to the anode pole side air space is changed into electric power falls.

[0008]In consideration of the above-mentioned fact, an appropriate amount of fuel gas is discharged from the anode pole side air space of the main part of a polymer electrolyte fuel cell, and, in any [ at the time of low loading and a heavy load ] case, the purpose of this invention is to provide a polymer electrolyte fuel cell device with high power conversion efficiency also in all loads.

[0009]

[Means for Solving the Problem]The polymer electrolyte fuel cell device according to claim 1, A main part of a polymer electrolyte fuel cell by which the anode pole side air space separated with an electrode conjugate and the cathode pole side air space are provided, and fuel gas is supplied to said anode pole side air space, The 1st flow control means arranged at a gas discharge path which discharges fuel gas which was supplied to said anode pole side air space, and was not consumed to the exterior of a main part of a polymer electrolyte fuel cell, The 2nd flow control means that can be opened and closed and that has been arranged at said at least one or more gas discharge paths, and was connected in parallel to said 1st flow control means, It has a load measurement means to measure power load to said main part of a polymer electrolyte fuel cell, and a control means which controls opening and closing of said 2nd flow control means so that a discharge of fuel gas from said gas discharge path fluctuates according to power load measured by said load measurement means.

[0010]According to the polymer electrolyte fuel cell device of the above-mentioned composition, at the time of low loading with few amounts of consumption of fuel gas by a main part of a polymer electrolyte fuel cell. A little fuel gas is made to discharge from the anode pole side air space by the 1st flow control means, power load to a main part of a polymer electrolyte fuel cell becomes high, and an amount of consumption of fuel gas increases, and a discharge of fuel gas from the anode pole side air space can be increased by the 2nd flow control means. Since fuel gas which contained an appropriate amount of high-concentration impurity gas from the anode pole side air space can be discharged by this even when power load to a main part of a polymer electrolyte fuel cell is low, and even when high, A utilization ratio of fuel gas can be prevented from being able to prevent an output of a fuel cell body from concentration of impurity gas in the anode pole side air space becoming high, and declining, and falling at the time of low loading.

[0011]When two or more 2nd flow control means are arranged here at a gas discharge path, Even if it makes the number of the 2nd flow control means made open according to a change in power load to a main part of a polymer electrolyte fuel cell fluctuate, it may be made to change the 2nd flow control means made open to that from which setting out of an exhaust

flow differs. It may carry out combining control which makes the number of the 2nd flow control means made open according to a change in power load to a main part of a polymer electrolyte fuel cell fluctuate, and control which changes the 2nd flow control means made open to that from which setting out of an exhaust flow differs.

[0012]It has the electromagnetism opening and closing valve to which the polymer electrolyte fuel cell device according to claim 2 was connected in series to a flow control valve to which said 2nd flow control means was connected in parallel to said 1st flow control means in the polymer electrolyte fuel cell device according to claim 1, and this flow control valve.

[0013]The 2nd flow control means is opened and closed and, according to the polymer electrolyte fuel cell device of the above-mentioned composition, a discharge of fuel gas from a gas discharge path fluctuates by changing an electromagnetism opening and closing valve into which state of an excited state and a non-excited state.

[0014]

[Embodiment of the Invention]Hereafter, the embodiment of this invention is described with reference to drawings.

[0015](Composition of an embodiment) The polymer electrolyte fuel cell device 30 concerning the embodiment of this invention is shown in drawing 1 and drawing 2. Since fundamental composition is common in the fuel cell body 10 explained based on drawing 3, the fuel cell body shown in drawing 2 attaches identical codes about a corresponding member, and omits the composition and the detailed explanation about operation. This polymer electrolyte fuel cell device 30 is provided with the armor case 32 of rectangular parallelepiped shape as shown in drawing 1. The door 36 supported so that the distribution power board 34 and opening and closing were possible is arranged, and the exhaust air part 38 is formed in the one side face of this armor case 32 under the distribution power board 34. Here, the door 36 is arranged at the inlet opening of the cylinder stowage (graphic display abbreviation) established in the inside of the armor case 32, and the vent hole of a large number which were open for free passage to the exhaust duct (graphic display abbreviation) of the armor case 32 is formed in the exhaust air part 38. The axle-pin rake 40 is stationed on the undersurface of the armor case 32 at each corner part, respectively.

[0016]In the armor case 32, various kinds of members concerning electric power generating of the fuel cell body 10 grade shown in drawing 2 are arranged, and the cylinder 42 with which it filled up with high-pressure hydrogen gas is stored exchangeable. A maximum of two of this cylinder 42 can be stored to the cylinder stowage within the armor case 32, and it becomes exchangeable by opening the door 36.

[0017]As shown in drawing 2, the cylinder 42 is provided with the hand valve 44, and this hand valve 44 is connected with the anode pole side air space 14 of the fuel cell body 10 with the hydrogen supply pipe 46. The regulators 48 and 50 and the electromagnetism opening and

closing valve 52 are arranged at the hydrogen supply pipe 46 in the middle of piping, The 1st step of regulator 48 decompresses the high-pressure (1 - 150 Kgf/mU) hydrogen gas supplied from the cylinder 42 to about 1-2 Kgf/mU, and the 2nd step of regulator 50 decompresses the hydrogen gas decompressed by the regulator 48 to about 0.05 Kgf/mU. The electromagnetism opening and closing valve 52 will be in an opened state at the time of impression of driver voltage (at the time of one), and will be in a closed state at the time (at the time of OFF) of un-impressing of driver voltage. Therefore, the hydrogen gas decompressed by the regulators 48 and 50 at the time of impression of the driver voltage to the electromagnetism opening and closing valve 52 is supplied to the anode pole side air space 14, and supply of hydrogen gas to the anode pole side air space 14 is intercepted at the time of un-impressing of the driver voltage to the electromagnetism opening and closing valve 52.

[0018]The main tank 54 for supplying water to the anode pole side air space 14 in the armor case 32 and the electromagnetism opening and closing valve 60 for supplementing this main tank 54 with pure water are arranged. When the electromagnetism opening and closing valve 60 serves as open, water is supplied to the main tank 54 from water treatment equipment or a subtank (graphic display abbreviation). If the main tank 54 is connected with the anode pole side air space 14 by the service pipe 68 by which the pump 64 and the filter 66 have been arranged and the pump 64 drives, the water filtered with the filter 66 will be supplied to the anode pole side air space 14 from the main tank 54. On the other hand, air is supplied to the cathode pole side air space 16 by the fan (sirocco fan) 70.

[0019]By supplying the air having contained oxygen which hydrogen gas and water are supplied to the anode pole side air space 14, and is reactant gas to the cathode pole side air space 16, the fuel cell body 10, Ionize hydrogen of the quantity according to power load on the anode pole 20, make this hydrogen ion react to the electron which has flowed through oxygen and the external circuit in the air on the cathode pole 22, and water is generated, and the electrical energy of a direct current is generated.

[0020]In the fuel cell body 10, the drainage ditch (graphic display abbreviation) is provided under the anode pole side air space 14, and this drainage ditch and main tank 54 are connected by the four drainage pipes 72. In order that the water supplied to the anode pole side air space 14 from the main tank 54 may maintain at a water retention state the electrolyte 18 in which a part consists of a polymers ion-exchange membrane, it is used, and it moves to the cathode pole 22 as $H^+$and$xH_2O$, and the remaining water is collected to a drainage ditch. The water collected to the drainage ditch in this fuel cell body 10 is collected through the four drainage pipes 72 to the main tank 54.

[0021]The gas exhausting pipe 74 is connected to near [ in the direction of a gas stream of the hydrogen gas supplied from the cylinder 42 ] a bottom flow position, and this gas exhausting pipe 74 has connected the anode pole side air space 14 with the anode pole side air space 14

to the main tank 54. The gas exhausting pipe 76 is connected to the main tank 54, and the gas exhausting pipe 76 has connected the main tank 54 with the mixer 78 for diluting hydrogen gas. The needle valve 80 for low loading, the needle valve 82 for heavy loads connected in parallel to this needle valve 80 for low loading, and the electromagnetism opening and closing valve 84 connected in series to this needle valve 82 for heavy loads are arranged at the gas exhausting pipe 76.

[0022]It flows into the gaseous layer on the circulating water which hydrogen gas and impurity gas (these are hereafter called unconverted gas) which did not react on the anode pole 20 were able to collect in the main tank 54 through the gas exhausting pipe 74 from the anode pole side air space 14. In the gaseous layer in the main tank 54, moisture is removed from the unconverted gas which flowed from the anode pole side air space 14, and this unconverted gas flows into the mixer 78 through the gas exhausting pipe 76. At this time, when the electromagnetism opening and closing valve 84 of the gas exhausting pipe 76 is OFF, the channel to the needle valve 82 for heavy loads serves as close, and the unreacted gas in the main tank 54 flows into the mixer 78 only through the normally open needle valve 80 for low loading. When the electromagnetism opening and closing valve 84 of the gas exhausting pipe 76 is one, the unreacted gas in the main tank 54 flows into the mixer 78 through the both sides of the needle valve 80 for low loading, and the needle valve 82 for heavy loads.

[0023]Here, the valve opening corresponding to the time of the low loading in which the power load to the fuel cell body 10 is lower than a predetermined threshold is set to the needle valve 80 for low loading, and the unconverted gas of the quantity which becomes proper at the time of low loading by this needle valve 80 for low loading is discharged from the anode pole side air space 14. The valve opening corresponding to the time of the heavy load in which the power load to the fuel cell body 10 is more expensive than a predetermined threshold is set to the needle valve 82 for heavy loads, The unconverted gas of the quantity which becomes proper at the time of the heavy load of the fuel cell body 10 with the both sides of the needle valve 80 for low loading and the needle valve 82 for heavy loads is discharged from the anode pole side air space 14.

[0024]On the other hand, the cathode pole side air space 16 is also connected with the mixer 78 by the air discharge pipe 86, and the fan (sirocco fan) 88 is connected in the middle of piping of this air discharge pipe 86. Therefore, the unconverted gas from the anode pole side air space 14, and the cathode pole side air space 16 and the air from the fan 88 flow into the mixer 78. In order that the mixer 78 may mix the unconverted gas and air having contained hydrogen gas and may prevent hydrogen explosion, it dilutes a unconverted gas with air and emits it to an exhaust duct so that hydrogen concentration may become below in 0.01 volume %. The exhaust gas emitted to this exhaust duct is discharged from the exhaust air part 38 of the armor case 32 in the device exterior.

[0025]Hydrogen gas is consumed with the fuel cell body 10, and the water which moved to the cathode pole side air space 16 from the anode pole side air space 14 is discharged with air to the mixer 78, Since moisture remains slightly also in the unconverted gas which flowed into the mixer 78 from the main tank 54, the circulating water in the main tank 54 decreases in number with the increase in the operating time of the polymer electrolyte fuel cell device 30. The water level sensor 90 is arranged at the main tank 54, and this water level sensor 90 will output a water level detecting signal to the control device 92, if the circulating water in the main tank 54 falls to a predetermined water level.

[0026]The control device 92 which received the water level detecting signal from the water level sensor 90 makes open the electromagnetism opening and closing valve 60, supplements the main tank 54 with water, and makes close the electromagnetism opening and closing valve 60 after progress of predetermined time. Under the present circumstances, only the time when the control device 92 was set up so that a gaseous layer might certainly remain on the circulating water in the main tank 54 makes the electromagnetic vaive 60 open.

[0027]The control device 92 which controls the whole device makes open the electromagnetism opening and closing valve 52 of the hydrogen supply pipe 46 in response to the seizing signal from the distribution power board 34, starts supply of hydrogen gas to the fuel cell body 10, is synchronized with the supply start of this hydrogen gas, and drives the pump 64, the fan 70, and the fan 88. The control device 92 makes close the electromagnetism opening and closing valve 52 of the hydrogen supply pipe 46 in response to the stop signal from the distribution power board 34, suspends supply of hydrogen gas to the fuel cell body 10, is synchronized with the supply interruption of this hydrogen gas, and stops the pump 64, the fan 70, and the fan 88.

[0028]On the other hand, after the direct current power which the fuel cell body 10 generated is changed into predetermined voltage with DC to DC converter 94, it is changed into exchange from a direct current with DC/AC inverter 96, and is sent to the ac output terminal 98. And the fuel cell body 10 generates the alternating current according to the power consumption of the external device (graphic display abbreviation) connected to the ac output terminal 98. The polymer electrolyte fuel cell device 30 of this embodiment is constituted as a self-conclusion type whose electric power supply from the outside is unnecessary. For this reason, it has the charge circuit 102 for charging the rechargeable battery 100 which is a power source used at the time of starting, and this rechargeable battery 100. This charge circuit 102 charges the rechargeable battery 100 with the surplus electric power of the fuel cell body 10.

[0029]The current sensor 104 for measuring the load to the fuel cell body 10 is arranged at wiring which connected the fuel cell body 10 to DC to DC converter 94 and the charge circuit 102. This current sensor 104 outputs the current detecting signal corresponding to the current of the direct current power which the fuel cell body 10 generated to the control device 92.

[0030](Operation of this embodiment) The control routine of the control device 92 of the polymer electrolyte fuel cell device 30 of this embodiment constituted as mentioned above is hereafter explained with reference to drawing 4. If supply of hydrogen gas is started from the cylinder 42 to the fuel cell body 10 in response to the seizing signal from the distribution power board 34 at Step 202 of drawing 4, More than a threshold (it is 20A when rating is 1kw) predetermined in the generating current of the fuel cell body 10, and less than a threshold are judged with the current detecting signal from the current sensor 104 at Step 204. At the above step 202,204, the electromagnetism opening and closing valve 84 of the gas exhausting pipe 76 has close.

[0031]When the generating current of the fuel cell body 10 carries out at Step 204 and it is judged as more than a threshold, When the electromagnetism opening and closing valve 84 of the gas exhausting pipe 76 is made open at Step 206 and the generating current of the fuel cell body 10 is judged to be less than a threshold at Step 204, the electromagnetism opening and closing valve 84 of the gas exhausting pipe 76 is made open at Step 208.

[0032]After controlling the needle valve 82 for heavy loads by Step 206,208, it is judged whether the stop signal inputted from the distribution power board 34. When it is judged that terminate a control routine when what the stop signal inputted at this step 210 is judged, and the stop signal has not inputted, it returns to Step 204 and the routine of Steps 204-210 is repeated.

[0033]As described above, in the polymer electrolyte fuel cell device 30 of this embodiment. When the generating current of the fuel cell body 10 is less than a threshold, the control device 92, It judges that the power load to the fuel cell body 10 is low, and the electromagnetism opening and closing valve 84 of the gas exhausting pipe 76 is made close, and it judges that the power load to the fuel cell body 10 is expensive when the generating current of the fuel cell body 10 is more than a threshold, and the electromagnetism opening and closing valve 84 of the gas exhausting pipe 76 is made open. Therefore, when the power load of the fuel cell body 10 is low, a unconverted gas flows into the mixer 78 from the anode pole side air space 14 only through the needle valve 80 for low loading. On the other hand, when the power load of the fuel cell body 10 is expensive, a unconverted gas flows into the mixer 78 from the anode pole side air space 14 through the both sides of the needle valve 80 for low loading, and the needle valve 82 for heavy loads, and the discharge of the unconverted gas from the anode pole side air space 14 increases as compared with the time of low loading. Since the hydrogen gas which contained an appropriate amount of high-concentration impurity gas from the anode pole side air space 14 can be discharged by this even when the power load to the fuel cell body 10 is low, and even when high, The utilization ratio of hydrogen gas can be prevented from being able to prevent the output of the fuel cell body 10 from the concentration of the impurity gas in hydrogen gas becoming high, and declining into the anode pole side air space

14, and falling at the time of low-electric-power load.

[0034]It is also possible to arrange two or more electromagnetism opening and closing valves which open and close the needle valve connected to the gas exhausting pipe 76 in parallel to the needle valve 80 for low loading and this needle valve every. For example, when a needle valve and two electromagnetism opening and closing valves have been arranged to each gas exhausting pipe 76. When the power load of the fuel cell body 10 becomes the 1st threshold, a gas discharge makes open the channel to the needle valve for middle loads set as the amount of middle classes, A gas discharge makes open the channel to the needle valve for heavy loads set as the large flow rate at the same time it makes close the channel to the needle valve for middle loads, when power load becomes the 2nd larger threshold than the 1st threshold, When power load becomes the 3rd larger threshold than the 2nd threshold, it becomes possible in two pieces to change the discharge of the unconverted gas from the anode pole side air space 14 to four steps by making simultaneously the channel to the needle valve for heavy loads into Kai.

[0035]

[Effect of the Invention]As explained above, according to the polymer electrolyte fuel cell device of this invention, even when the power load to the main part of a polymer electrolyte fuel cell is low, and even when high, an appropriate amount of fuel gas can be discharged from the anode pole side air space.

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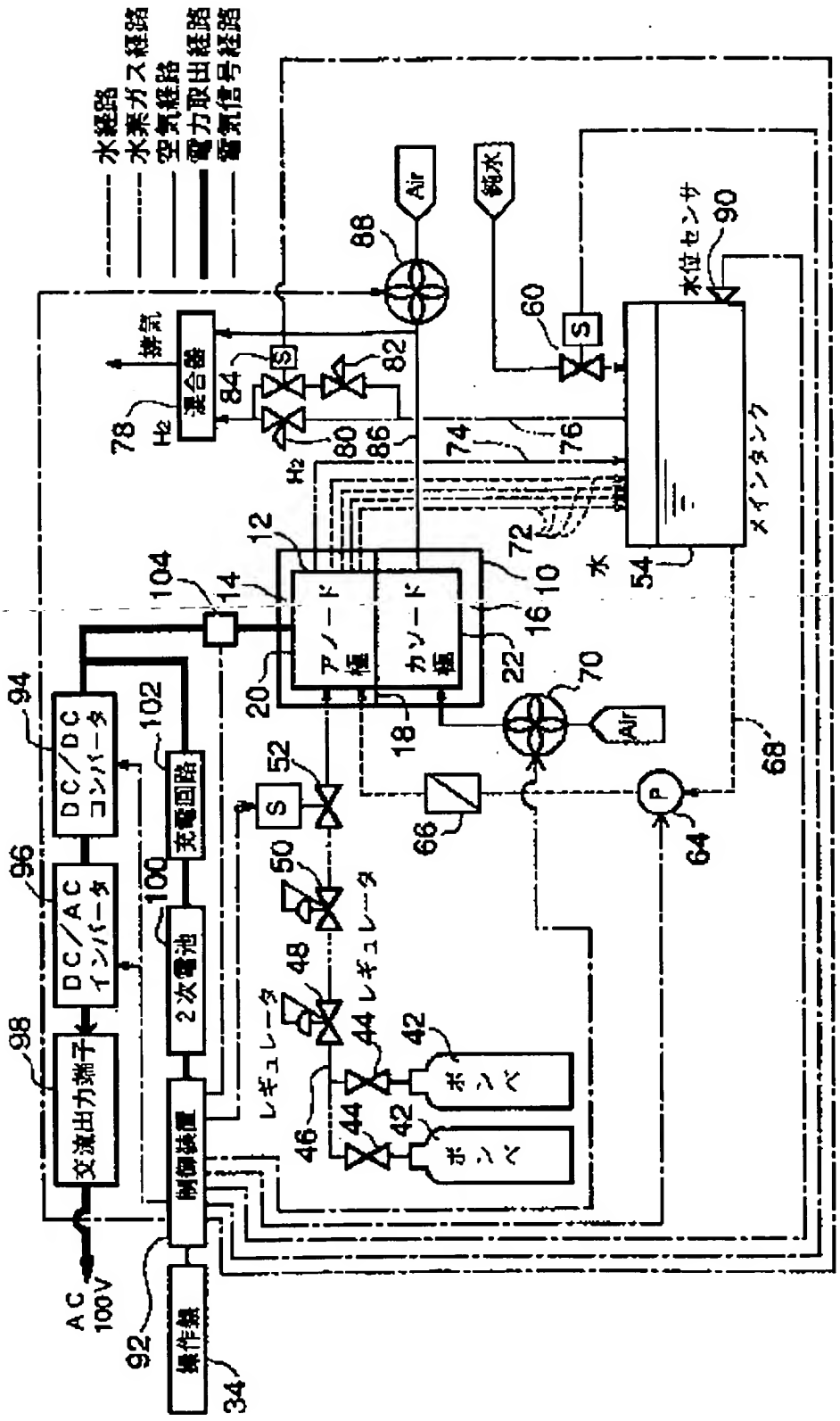
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制御装置
AC 100V
92
操作盤
34